

Clean Claims as Amended
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provide two selected wavelengths.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

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Figure 2 is a schematic drawing showing a light emitting diode (LED) illumination source device 200 for a flow cytometer according to the present invention. The integrated lens usually present on LEDs is absent. The LED can be fabricated without the lens or the lens 208 can be removed by cutting. When the lens is removed by cutting, the resulting cut surface should then be polished until a transparent, thin, flat layer of plastic covers the emitting element. LED 202a is an example of this. Alternatively, a side-emitting LED 202b in a (lensless) flat pack can be used.

Note that while flow cytometry is extensively discussed herein, the same apparatus and methods apply to general flow particle detection systems.

LED 202 provides light 203 at a selected wavelength when forward biased. Optical element 204 is preferably a ball lens, though a convex lens with a very small focal length would suffice. Ball lens 204 collects nearly all of the light from LED 202 and collimates it to beam 205. Optical element 206, for example a convex lens then focuses the light 207. The focal length of lens 206 is selected to focus the light to a tight beam at the sample stream of the cytometer (see Figure 3).

Figure 3 is a schematic drawing showing a flow cytometer 300 which utilizes an LED illumination source device 200 according to the present invention. LED Device 200 focuses light 207 onto cytometer sample

CLAIMS

1. An LED illumination source device for use in a flow particle detection device comprising:

an LED for providing light at a selected wavelength; and

an optical element for collecting nearly all of the light from the LED and concentrating the collected light at a selected volume within a flow sample stream.

2. The device of claim 1, wherein the optical element comprises:

a collecting element having a small focal length for collecting the light from the LED and substantially collimating it to a roughly parallel beam of light; and

a focussing element for focussing the collimated beam.

3. The device of claim 1 wherein the collecting element is a ball lens.

4. The device of claim 1 wherein the LED is a composite LED which generates light at two wavelengths.

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5. The device of claim 1 wherein the LED is a side emitting, flat pack, lensless LED.

6. The device of claim 1 wherein the flow particle detection device is a flow cytometer.

7. Particle detection apparatus for identifying particles in a sample stream moving through a flow zone, the sample stream containing target particles, the apparatus comprising:

equipment for passing the sample stream through the flow zone;

an illumination device for illuminating the sample stream within the flow zone; and

a detector assembly for detecting light emitted or scattered from illuminated target particles within the flow zone;

wherein the illumination device includes an LED illumination source device including -

an LED for providing light at a selected wavelength; and

an optical element for collecting nearly all of the light from the LED and concentrating the collected light at a selected volume within a flow sample stream.

8. The apparatus of claim 7 wherein the optical element comprises:

a collecting element having a small focal length for collecting nearly all of the light from the LED and substantially collimating it to a parallel beam of light; and

a focussing element for focussing the collimated beam.

9. The apparatus of claim 8 wherein the collecting element is a ball lens.

10. The apparatus of claim 7 wherein the LED is a composite LED which generates light at two wavelengths.
11. The apparatus of claim 10 wherein the detector detects light emitted or scattered from illuminated target particles resulting from illumination at both selected wavelengths within the flow zone.
12. The apparatus of claim 11, wherein the sample stream includes two fluorescent dyes and the selected wavelengths cause the two dyes to emit at different wavelengths.
13. The apparatus of claim 7 wherein the particle detection apparatus is a flow cytometer.

14. Particle detection apparatus for identifying particles in a sample stream moving through a flow zone, the sample stream containing target particles, the apparatus comprising:

equipment for passing the sample stream through the flow zone;

an illumination device for illuminating the sample stream within the flow zone with two selected wavelengths; and

a detector assembly for detecting light emitted or scattered from illuminated target particles resulting from illumination at both selected wavelengths within the flow zone;

wherein the illumination device includes an LED illumination source device including -

an LED for providing light at the two selected wavelengths; and

an optical element for collecting nearly all of the light from the LED and concentrating the collected light at a selected volume within a flow sample stream.

15. The apparatus of claim 14, wherein the detector assembly comprises two detectors for detecting emitted light at two wavelengths.

16. The apparatus of claim 14, wherein the sample stream includes two fluorescent dyes and the selected wavelengths cause the two dyes to emit at different wavelengths.

17. The apparatus of claim 16, wherein the detector assembly

comprises two detectors for detecting emitted light at the two wavelengths.

18. The apparatus of claim 14 wherein the optical element comprises:

a collecting element having a small focal length for collecting nearly all of the light from the LED and substantially collimating it to a roughly parallel beam of light; and

a focussing element for focussing the collimated beam.

19. The apparatus of claim 18 wherein the collecting element is a ball lens.

20. The apparatus of claim 14 wherein the particle detection apparatus is a flow cytometer.